A wheel to recycle energy

A device that has appeared on the market in Japan allows you to let in fresh air on a winter day without letting the cold in. It is a wheel, which fits into an opening in the wall and slowly rotates. Cold fresh air passed through one half of the wheel by a fan is warmed by the warm stale air passed out through the other.

Engineers call such wheels rotary heat exchangers. The idea is comparatively old, having been first used 50 years ago in Sweden for heating a boiler's combustion air by hot air going up the stack.

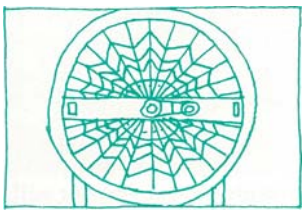
But only in the last decade or so has the concept been applied to air-conditioning installations, where wheels from 4 m in diameter, down to the diminutive 20-cm Japanese unit, have been developed. They are now widely used in the United States, Japan, and Europe.

In Australia, Mr Bob Dunkle at the CSIRO Division of Mechanical Engineering in the early 1960s saw their possibilities for energy savings in air-conditioning, and set to work to design an advanced unit. The result was a rotary heat exchanger that performed significantly better than overseas versions.

Following the initiative, a Melbourne engineer formed a company, Rotary Heat Exchangers Pty Ltd, to manufacture the new design.

The Australian product is particularly attractive for hospitals, where many areas require 100% fresh air to prevent the spread of infection. Instead of conditioning air in the plant room, ventilating the hospital once with it, and then exhausting it, the idea is to return the spent air to the plant room. Here rotary heat exchangers recover the energy from the air and transfer it to fresh unconditioned air.

The company has now supplied more than 70 units to air-conditioning plants throughout Australia, mostly to hospitals in South Australia and Western Australia.



Modbury Hospital in Adelaide was built with a 30% saving in size of the heating and cooling plant because this was designed to use rotary heat exchangers. It is estimated that the running cost of the air-conditioning system in this 300-bed hospital is reduced by $5000 per year because in that time the plant consumes 2600 gigajoules less energy.

Because of the increasing cost of power and fuel, the use of rotary heat exchangers in standard air-conditioning installations, which recycle about 80% of the stale air, may become economic. Similarly, operators of low-temperature industrial air driers could also benefit from the energy savings possible with the units.

At the Division, Dr Peter Banks, Dr Don Close, and Mr Bill Ellul are continuing research into rotary heat exchangers.

The present Australian wheel is constructed from a ribbon of polyester film wound in a spiral around the hub. Small inserts create spaces between the layers of film so that air can pass through. It is the film that carries the heat away from one air stream and, after half a revolution, transfers it to the other.

This wheel therefore recycles heat associated with temperature differences — sensible heat. However, energy can also be lost in the exhaust stream of an air-conditioning system as latent heat — the heat bound up in the water-vapour content (humidity) of the air.

In southern Australia this is not a large amount, but in the humid tropical regions of the north (where fresh air needs to be dehumidified as well as cooled) it is. The energy required is about five times that needed to remove the sensible heat.

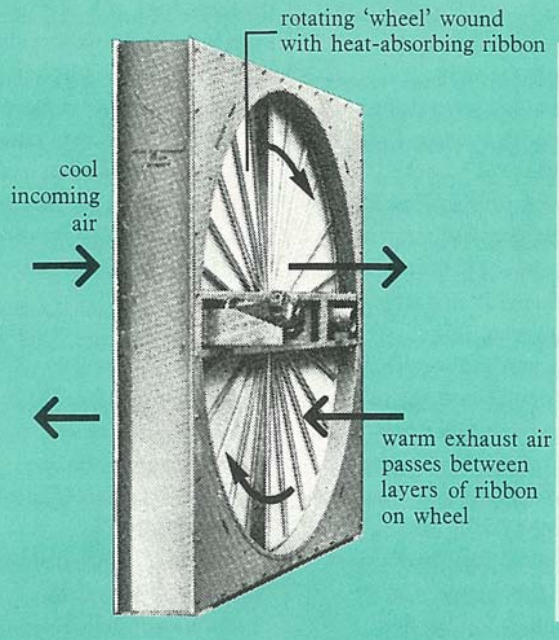
To conserve this energy, the research team are experimenting with a rotary heat exchanger that uses an absorbent material as the exchange medium. The material becomes damp by absorbing moisture from the incoming air and is then dried out by the exhaust air.

The team members are now trying to find a suitable material, in particular one that does not become dripping wet. In collaboration with the CSIRO Division of Textile Industry, they have tried wool — with good results, although some problems remain to be solved.

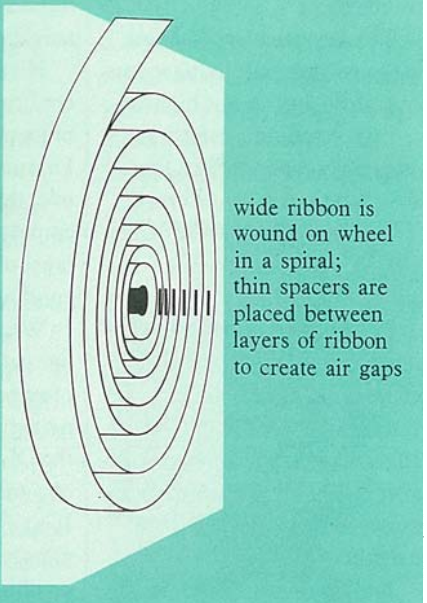
The results of their laboratory tests indicate that a 300-bed hospital in Townsville would save about $20 000 a year in operating costs using a wool ribbon. However, the CSIRO engineers consider that a better result should be possible with an even more absorbent material.

Regenerator research, development and applications in Australia. R. V. Dunkle, P. J. Banks, and W. M. J. Ellul. In 'Proceedings, International Institute of Refrigeration, Joint Meeting of Commissions C2, D1, D2, D3 and E1, Melbourne, 1976'. (International Institute of Refrigeration: Paris 1976.)

How a rotary regenerator saves 'waste' heat



How it's made



As the regenerator slowly rotates, it transfers heat — via the ribbon — from the warm exhaust air to incoming fresh air.